California Department of Conservation

Six-Month Report of Beverage Container Recycling & Significant Carbon Reductions

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Executive Summary

The beverage container recycling rate rose sharply to 76 percent in the first six months of calendar year 2008 as compared to 71 percent for the same period in 2007. The combined recycling rate for aluminum, bimetal, glass, and plastic beverage containers for the six-month period January through June 2008 was up 5 percentage points from the same period in 2007. The continued rise in beverage container recycling coincides with an increase in California Refund Value (CRV) and additional public education and outreach resources made available to promote the CRV increase.

Effective January 1, 2007, California consumers began receiving 5 cents for beverage containers under 24 ounces, and 10 cents for containers 24 ounces or larger for recycling these beverage containers. Legislation that increased the refund value also allocated, on a one-time basis, an additional $5 million in marketing dollars to inform the public about the new refund values. Combined with the existing marketing campaign to promote bottle and can recycling, the comprehensive communications effort involving news media coverage and promotional advertising helped promote recycling by Californians.

The combined recycling of all beverage container types increased nearly 600 million containers in the first six months of 2008 as compared to the same period in 2007. A total of 7.58 billion aluminum, glass, plastic, and bimetal beverage containers were returned for recycling, whereas, a total of 10 billion aluminum, glass, plastic, and bimetal beverage containers were sold during this January through June 2008 period.

The improved economics of recycling and increased public awareness of the beverage container recycling program are contributing factors that continue to deliver positive benefits to California's environment. Products manufactured from recycled feedstock require less energy than using virgin resources. Lower energy consumption results in less greenhouse gas emissions which are considered the primary cause of climate change.

Each year California consumes nearly 714 million barrels of oil[1] and emits 479 million metric tons of greenhouse gasses[2]. California's beverage container recycling effort from January through June 2008 saved the equivalent of 3.3 million barrels of oil and reduced the equivalent of 311,000 metric tons of carbon in greenhouse gas emissions[3]. The impact of the increase of nearly 600 million beverage containers alone saved the equivalent of 201,000 barrels of oil and reduced the equivalent of 16,000 metric tons of carbon in greenhouse gas emissions, which equates to eliminating the energy consumption of 11,000 households for one year.[4]

Background of the California Beverage Container Recycling Program

California's Beverage Container Recycling Program (Program) is unique among the states that have a beverage container return system. In other bottle deposit states, the cans and bottles are returned to the store from which the containers were purchased. Californians enjoy a more convenient form of container recovery with over 2,900 certified recycling locations statewide. The recycling system in California provides a convenient and efficient way to recycle beverage containers and is a source of non-tax-dollar funding for various recycling and litter reduction programs throughout the State.

The Division of Recycling (Division), California Department of Conservation administers the Program. Enacted by the California Beverage Container Recycling and Litter Reduction Act (Act) in 1986, the Program aspires to make beverage container recycling integral to the California economy. The primary goal of the Program as set in statute is to achieve an 80 percent recycling rate for all aluminum, glass, plastic, and bimetal beverage containers sold in California and provide convenient recycling opportunities to consumers.

The Program is funded through redemption payments made by beverage distributors on each beverage container sold in the state. Redemption payment revenues are deposited into the California Beverage Container Recycling Fund (Fund). Consumers receive CRV from the Fund when they return empty beverage containers to certified recycling centers.

Table #1 below shows the recent history of the changes in redemption payments and refund values assessed on beverage containers.

Table #1 – History of Redemption Payments and Refund Values per Beverage Container Since 2000

Period	Redemption Payments		Refund Value (CRV)	
	Less than 24 oz.	24 oz. or more	Less than 24 oz.	24 oz. or more
Jan 1, 2000 to Dec 31, 2003	$0.025	$0.05	$0.025	$0.05
Jan 1, 2004 to Dec 31, 2006	$0.04	$0.08	$0.04	$0.08
Jan 1, 2007 to Jun 30, 2007	$0.04	$0.08	$0.05	$0.10
July 1, 2007 to date	$0.05	$0.10	$0.05	$0.10

Beverage containers currently covered by the Program include those filled with carbonated mineral and soda water and other similar carbonated soft drinks, non-carbonated soft drinks, wine coolers and distilled spirit coolers, beer and malt beverages, non-carbonated water including non-carbonated mineral water, sport drinks, coffee and tea drinks, vegetable juice in containers 16 ounces or less, carbonated and non-carbonated fruit drinks that contain any percentage of fruit juice and 100 percent fruit juices that are packaged in containers less than 46 ounces.

California's Program currently includes over 22.1 billion containers, of which over 15 billion were returned for recycling in the 12 months ending June 30, 2008.

Analysis of Recycling Rates

The All Materials recycling rate for January through June 2008 was 76 percent, up from 71 percent for the same period in 2007. The increases in recycling rates for the four high volume beverage container material types for January through June 2008, versus the same period in 2007 are: 2 percentage points for aluminum, 8 percentage points for glass, 5 percentage points for PET plastic, and 20 percentage points for HDPE plastic. The recycling rates for the four January through June periods by material type are shown in Chart #1 below.

Chart #1 –Beverage Container Recycling Rates, January through June 2005, 2006, 2007, and 2008

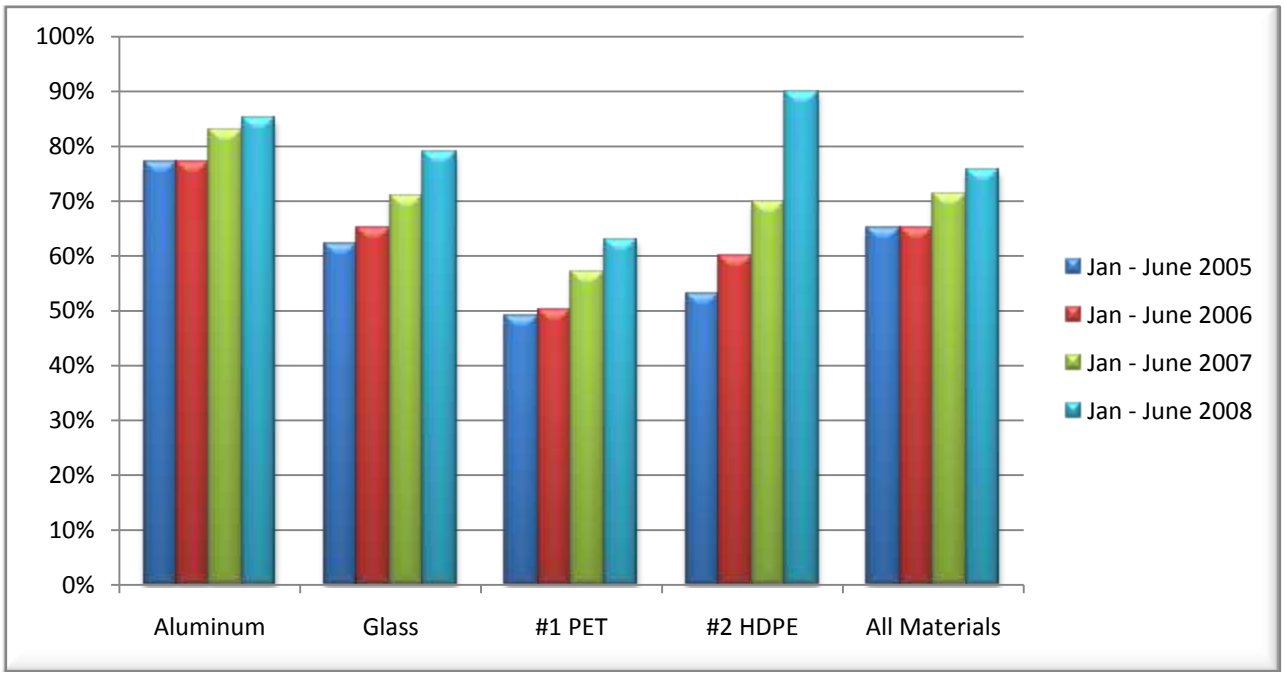


Chart #2 below shows the number of beverage containers returned for the January through June 2007 and 2008. Between the two periods, all of the high volume material types experienced growth in the number of beverage containers returned. Most notably, the number of PET plastic beverage containers returned increased by over 16 percent from 2.1 billion containers for the January through June 2007 period to 2.4 billion containers. HDPE plastic beverage containers had an increase of returned containers by 17 percent from 123 million to 144 million. As a result, this percentage seems exaggerated since HDPE beverage container numbers are significantly lower when in comparison to the aluminum, glass and PET plastic beverage container numbers which are in the billions.

Chart #2 – Beverage Containers Returned, January through June 2007 and 2008

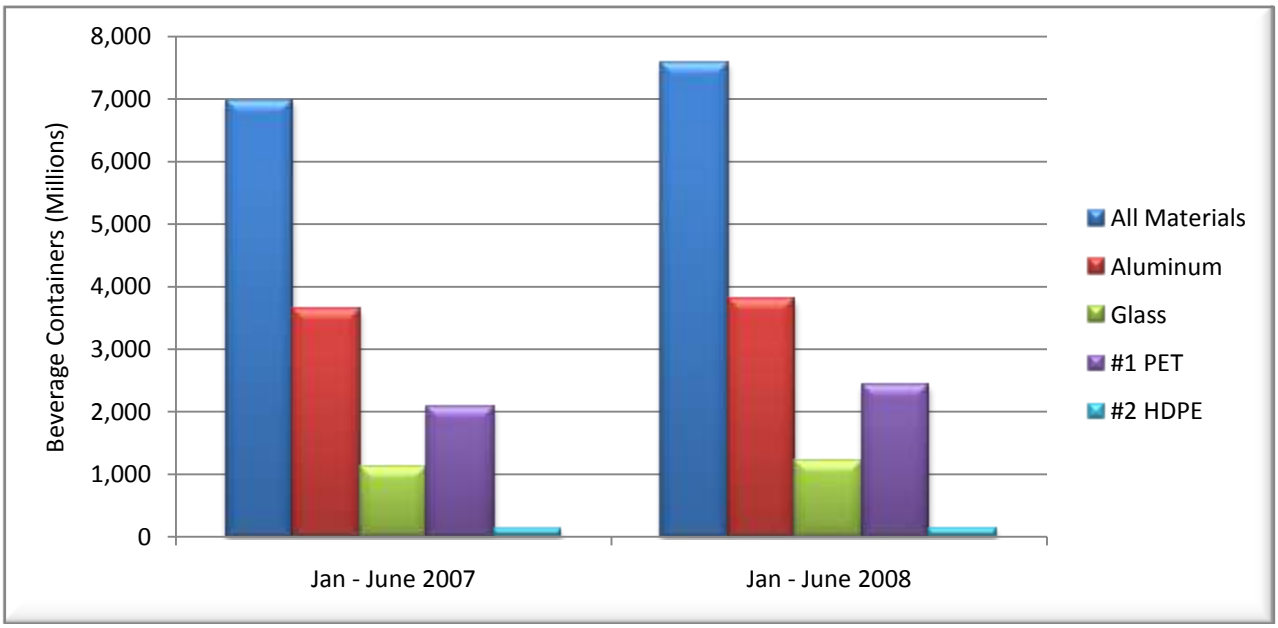
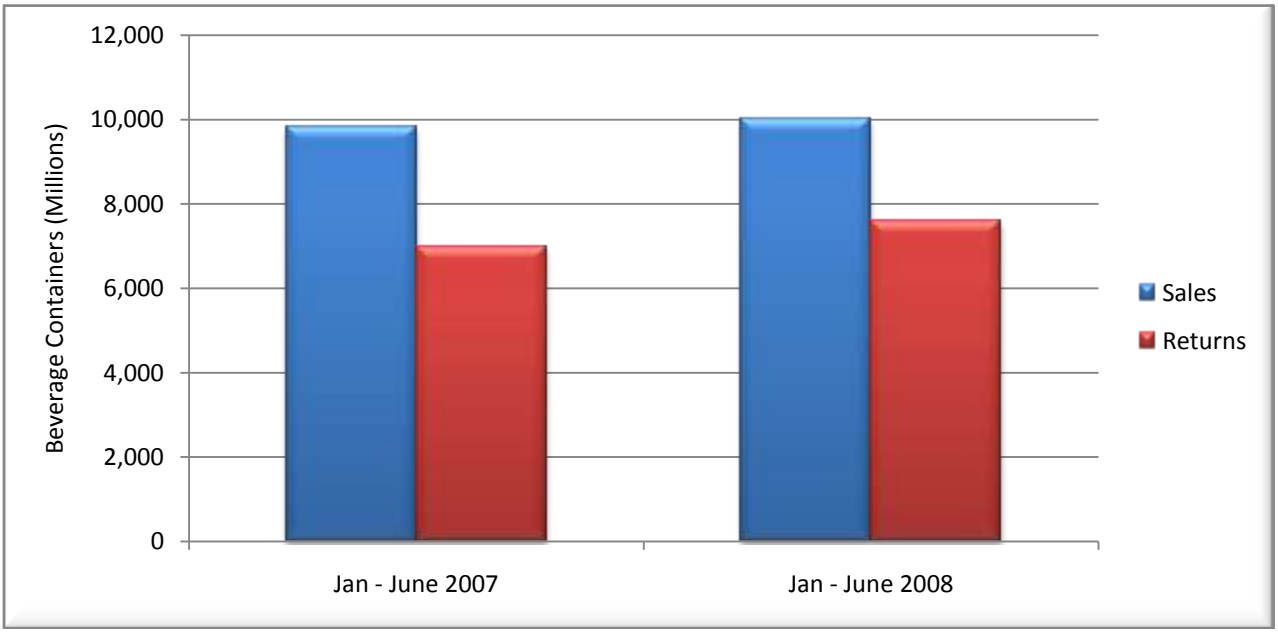


Chart #3 below shows a side-by-side comparison of all material beverage container sales and returns for the 6-month periods January through June 2007 and 2008. Between the two periods shown in the chart, beverage container sales increased 2 percent while returns increased 9 percent.

Chart #3 – All Materials Beverage Containers Sales and Returns, January through June 2007 and 2008



Environmental Benefits from Recycling Beverage Containers

Recycling delivers a wide array of benefits to the environment. Recycling conserves natural resources and reduces the amount of material that would otherwise be landfilled or littered. Furthermore, recycling saves energy and results in the reduction of greenhouse gas (GHG) emissions and air pollution.

Beverage container recycling reduces GHG emissions in two ways: 1) from the lower energy requirements needed to manufacture products from scrap material versus using ore and other raw materials; and 2) from the avoidance of non-energy related GHG emissions occurring during the transformation of raw materials to market-ready feedstock. An example of non-energy related GHG emissions is the emission of methane (CH_4) during the production of plastic resins or the conversion of limestone to lime that occurs during the production of aluminum.

Each beverage container material type has unique processes and energy requirements for manufacturing and recycling. The proportion of energy saved from beverage container recycling by material type, as opposed to disposal and restarting the product lifecycle from virgin material, is listed in table #2 that follows[5].

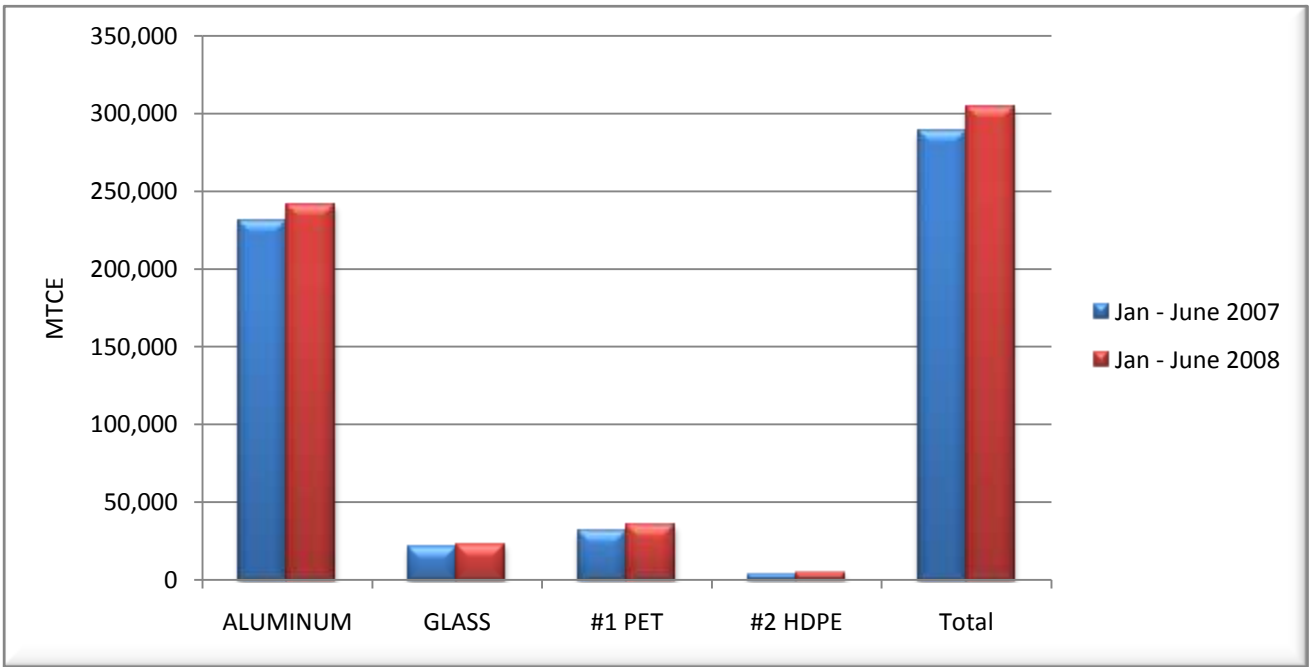
Table #2 – Energy Saved by Beverage Container Recycling, by Material Type

Material Type	Proportion Energy Saved by Recycling
Aluminum	95%
Glass	30%
Plastic (all resin types)	70%

Lower energy consumption achieved through recycling results in the reduction of GHG emissions. If all beverage containers sold in California were landfilled, the reduction in GHG emissions would be zero.

The total reductions of GHG emissions based on the total volume of all beverage container materials returned for recycling in California for the January through June 2008 period is 311,000 metric tons of carbon equivalent (MTCE), up from 293,000 MTCE in the same 6-month period in 2007[6]. Chart #4 that follows shows the reduction of GHG emissions by material type for the two periods.

Chart #4 – Reduction of GHG Emissions, Beverage Containers Returned, January-June 2008 and 2007



Aluminum Beverage Container Life Cycle

The process of producing aluminum beverage containers from virgin materials requires the most energy and produces the most GHG emissions of all beverage container material types. However, producing aluminum beverage containers from recycled aluminum reduces the energy consumption and associated GHG emissions by 95 percent.

The primary ore material for aluminum is bauxite which contains aluminum oxide, known as alumina. Most of the bauxite and alumina used in the United States is mined from Jamaica and Australia; there are currently no commercially mined aluminum deposits in the United States[7].

Producing primary aluminum is extremely energy intensive. Bauxite must be refined by removing highly stable compounds naturally occurring in the ore to yield the intermediate product alumina which has the consistency of a white powder. Then a high-amperage electrical current is run through the alumina mixture, in a process known as electrolysis, to yield metallic aluminum. Electrolysis requires the use of direct current (DC) as opposed to the alternating current (AC) used in homes. The immense amounts of power required to produce aluminum is the reason that aluminum plants are almost always located in areas where affordable electrical power is readily available[8]. One percent of all the energy used in the United States is used in the making of aluminum.[9]

Producing aluminum beverage containers from recycled aluminum requires only five percent of the energy needed to produce the same containers from primary aluminum. Recycled aluminum is collected from recycling programs statewide, delivered to a processor for baling, and shipped to a smelter where the aluminum is shredded, cleaned of contaminants, and blended with virgin aluminum to form ingots with a standard length of 25 feet and weight of 30,000 pounds[10]. The ingots are then delivered to a mill and formed into sheets that are sold to container manufacturers to produce new aluminum cans.

From January through June 2008, a total of 3.79 billion aluminum beverage containers were recycled. By recycling these beverage containers, Californians saved resources and reduced emissions equivalent to:

- 240,000 MTCE
- 2.3 million barrels of oil
- 125,000 households' annual energy consumption[11]

Glass Beverage Container Life Cycle

Glass was discovered over 5,000 years ago. Glass is one of the most stable materials known, and a glass bottle deposited as litter would take over one million years to break down naturally[12]. Producing glass beverage containers, glass bottles and jars from recycled glass reduces the energy consumption and associated GHG emissions by approximately 30 percent.

Glass is manufactured from sand, also known as silica, soda ash, and limestone, all of which are readily available within the United States. The feedstock used to produce glass is blended with various amounts of finely crushed and cleaned recycled glass, known as "cullet." Very little glass is produced entirely from virgin materials.

Glass manufacturing requires heating the feedstock in a furnace. The glass melt from the furnace is then molded, with pigments added to yield colored glass, into the desired shape and cooled to produce a finished glass container. The production of fiberglass is similar to container glass except that the molten liquid is formed into thin fibers. The process of producing high quality glass, as required by container and fiberglass manufacturers, is extremely sensitive to the presence of contaminants such as ceramics, metals, other fine particles such as dirt, and other types of glass with high melting points such as light bulbs and Pyrex glass.

Glass feedstock containing a higher proportion of cullet requires lower furnace temperatures. Manufacturing processes for container glass and fiberglass can tolerate feedstock containing up to 70 percent cullet[13]. Thus the more cullet that is used in the manufacturing process, the greater the energy savings and reductions in GHG emissions.

Most glass beverage containers returned for recycling in California are sold to beneficiating processors, delivered either color-sorted or non-sorted "three-mix" glass. The beneficiating processor removes fine contaminants and produces cullet used for manufacturing new glass containers or fiberglass.

From January through June 2008, a total of 1.22 billion glass beverage containers were recycled. By recycling these beverage containers, Californians saved resources and reduced emissions equivalent to:

- 23,000 MTCE
- 145,000 barrels of oil
- 8,000 households' annual energy consumption[14]

Plastic Beverage Container Life Cycle

Plastic is a synthetic material that is capable of being molded, extruded, cast into various shapes and films, or drawn into filaments and used as textile fibers. The first known plastic was created from cellulose in 1862[15]. Modern plastic is manufactured from fossil fuel hydrocarbons such as oil, natural gas, or coal, and the first plastic created from hydrocarbon resins was developed in 1907[16]. Today plastic has become a useful and inexpensive material, yet plastic litter has also come to symbolize our inability to manage our consumption and growth.

Plastic is made by heating hydrocarbons in a "cracking process" to break down the large organic molecules into smaller molecules such as ethylene, propylene, and styrene, which are collectively known as monomers[17]. The monomers are then chemically bonded to form large molecules consisting of long monomer chains known as polymers[18]. Different combinations of monomers yield plastic resins with different properties. After the base resin is produced, additives such as colorants, antioxidants, and foaming agents are included in the mix to yield finished feedstock,[19] which is then sold to a product manufacturer.

Plastic bottles are produced first by extrusion then by blow molding. During extrusion, the plastic is loaded into a hopper, fed into a heated chamber, forced out through a small opening, known as a die, and cast into a thick hollow tube with one end open and threaded[20]. In the blow molding process, the tube is blown with compressed-air to conform to a chilled bottle-shaped mold[21]. Most plastic bottles are manufactured from two plastic resins, PET (Polyethylene Teraphalate) or HDPE, (High-density Polyethylene).

Plastic bottle recycling bypasses the cracking and polymerization processes as well as the extraction and refining of hydrocarbons, thereby saving 70 percent of the energy required using virgin materials. Plastic is collected and sorted by resin type, baled, and shipped to a plastics bottle reclaimer. By some estimates, as much as 50 percent of the recycled plastic from California is exported to reclaimers in Asia. The reclaimer soaks the bottles in a large bath to remove labels and separate screw caps and other components from the body of the bottle. Then once cleaned and freed of contaminants, the bottles are shredded and formed into pellets or sold as flake to product manufacturers. In the case of PET plastic, the material may be spun into filaments to be used to make polyester garments.

From January through June 2008, a total of 2.43 billion PET plastic beverage containers were recycled. By recycling these beverage containers, Californians saved resources and reduced emissions equivalent to:

- 36,000 MTCE
- 786,000 barrels of oil
- 42,000 households' annual energy consumption[22]

From January through June 2008, a total of 144 million HDPE plastic beverage containers were recycled. By recycling these beverage containers, Californians saved resources and reduced emissions equivalent to:

- 5,000 MTCE
- 106,000 barrels of oil
- 6,000 households' annual energy consumption[23]

Conclusion

California leads the nation in the volume of beverage containers recycled. For the six-month period January through June 2008, Californians recycled over 7.58 billion beverage containers versus 6.98 billion beverage containers recycled during the same period in 2007. Recycling beverage containers saves energy, reduces GHG emissions, and results in less litter deposited on the landscape and in the ocean. The effect of recycling 7.58 billion beverage containers saved the equivalent of 3.3 million barrels of oil and reduced the equivalent of 311,000 metric tons of carbon in GHG emissions[24].

Appendices

Appendix A1: Biannual Report of Beverage Container Sales, Returns, & Redemption rates

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[1] Energy Information Administration Database, retrieved from http://www.eia.doe.gov/emeu/states/sep_fuel/html/fuel_use_pa.html
[2] California Environmental Protection Agency, Air Resources Board, retrieved from http://www.arb.ca.gov/cc/inventory/data/tables/rpt_Inventory_IPCC_Sum_2007-11-19.pdf
[3] Based on Waste Reduction Model (WARM) developed by the US Environmental Protection Agency, retrieved from http://epa.gov/climatechange/wycd/waste/calculators/Warm_home.html
[4] ibid
[5] "The truth about recycling", *The Economist* (June 7, 2007), retrieved from http://www.economist.com/search/displaystory.cfm?story_id=9249262&CFID=24653113&CFTOKEN=67078453
[6] US Environmental Protection Agency, see note 3
[7] Information provided courtesy of Reynolds Aluminum, ALCOA, and the Aluminum Institute, retrieved from http://www.rocksandminerals.com/aluminum/process.htm
[8] ibid
[9] Greener World Media, Inc, retrieved from http://www.climatebiz.com/sections/toolsresources_detail.cfm?LinkAdvID=66054
[10] Earth 911, retrieved from http://earth911.org/recycling/aluminum-can-recycling/how-is-an-aluminum-can-recycled/
[11] US Environmental Protection Agency, see note 3
[12] Cleanup Australia Limited, retrieved from http://www.cleanup.org.au/PDF/au/cua-glass-fact-sheet.pdf
[13] Glass Packaging Institute, retrieved from http://www.gpi.org/recycling/faq/#faq2
[14] US Environmental Protection Agency, see note 3
[15] American Plastics Council, retrieved from http://lifecycle.plasticsresource.com/step1.html
[16] ibid
[17] American Chemistry Council, retrieved from http://www.plasticsresource.com/s_plasticsresource/sec.asp?TRACKID=&CID=126&DID=228
[18] ibid
[19] ibid
[20] ibid
[21] ibid
[22] US Environmental Protection Agency, see note 3
[23] ibid
[24] ibid